

Claims:

1. A nitride semiconductor laser device provided with a window layer on a light-emitting end face of the resonator which comprises an active layer of nitride semiconductor between the n-type nitride semiconductor layers and the p-type nitride semiconductor layers, characterized in that:

at least the radiation-emitting end face of said resonator is covered by said window layer comprising monocrystalline nitride of general formula $\text{Al}_x\text{Ga}_{1-x-y}\text{In}_y\text{N}$, where $0 \leq x+y \leq 1$, $0 \leq x \leq 1$ and $0 \leq y < 1$, especially nitride of general formula $\text{Al}_x\text{Ga}_{1-x}\text{N}$ ($0 \leq x \leq 1$) having a wider energy gap than that of the active layer and being formed at a low temperature so as not to damage said active layer.

2. The nitride semiconductor laser device according to claim 1, characterized in that the thickness of the end face window layer is higher than 50 \AA , and is equal to integer multiplicity of the emitted radiation wave length ($n\lambda$).

3. The nitride semiconductor laser device according to claim 1, characterized in that the end face window layer of monocrystalline $\text{Al}_x\text{Ga}_{1-x}\text{N}$ ($0 \leq x \leq 1$) is formed in the supercritical ammonia-containing solution.

4. The nitride semiconductor laser device according to claim 3, characterized in that at least the p-type contact layer of the resonator is covered by a mask.

5. The nitride semiconductor laser device according to claim 3, characterized in that the resonator end face window layer contains at least one of the elements of Group I.

6. The nitride semiconductor laser device according to claim 1, characterized in that the resonator active layer has a structure of a (multi)quantum-well layer comprising at least one InGaN well layer or InAlGaN well layer.

7. The nitride semiconductor laser device according to any one of claims 1 to 6, characterized in that the nitride semiconductor laser device structure is formed on the substrate selected from the group consisting of GaN substrate, preferably monocrystalline GaN substrate, sapphire substrate, spinel substrate, ZnO substrate, SiC substrate, ELOG-type

substrate and a substrate provided with a nitride semiconductor having a concavo-convex face.

8. The nitride semiconductor laser device according to any one of claims 1 to 7, characterized in that the nitride semiconductor laser device structure is formed on C-plane, A-plane or M-plane of monocrystalline GaN substrate.

9. The nitride semiconductor laser device according to claim 1, characterized in that the nitride semiconductor laser device structure is formed on C-plane of monocrystalline GaN substrate and the resonator end face window layer is grown on M-plane or A-plane.

10. The nitride semiconductor laser device according to claim 1, characterized in that the nitride semiconductor laser device structure is formed on A-plane of monocrystalline GaN substrate, and the window layer is formed on C-plane or M-plane of the resonator radiation-emitting end face.

11. The nitride semiconductor laser device according to claim 1, characterized in that the nitride semiconductor laser device structure is formed on M-plane of monocrystalline GaN substrate, and the window layer is formed on C-plane or A-plane of the resonator radiation-emitting end face.

12. A method for improving the performance of a nitride semiconductor laser device having a resonator including an active layer comprising nitride semiconductor between n-type nitride semiconductor layer and p-type nitride semiconductor layer, in which in a first process a laser device structure is etched or cleaved and a pair of the opposite resonator end faces are formed, characterized in that

in a second process the radiation-emitting end face of said resonator is covered by a window layer of monocrystalline nitride of general formula $\text{Al}_x\text{Ga}_{1-x-y}\text{In}_y\text{N}$, where $0 \leq x+y \leq 1$, $0 \leq x \leq 1$ and $0 \leq y < 1$, especially nitride of general formula $\text{Al}_x\text{Ga}_{1-x}\text{N}$ ($0 \leq x \leq 1$), having a wider energy gap than that of the active layer, at low temperature so as not to damage said active layer.

13. The method for improving the performance of a nitride semiconductor laser device according to claim 12, characterized in that during the second process the resonator end face window layer is formed in supercritical ammonia-containing solution.

14. The method for improving the performance of a nitride semiconductor laser device according to claim 13, characterized in that during the second process the resonator end face window layer is formed after at least upper surface of resonator p-type contact layer is covered by a mask having higher or same chemical resistance than that of end face window layer material in supercritical ammonia-containing solution.

15. The method for improving the performance of a nitride semiconductor laser device according to claim 14, characterized in that the mask is selected from the group consisting of SiO_2 , Si_3N_4 , AlN and Ag .

16. The method for improving the performance of a nitride semiconductor laser device according to claim 12, characterized in that the resonator end face window layer is formed by depositing monocrystalline nitride layer in the supercritical ammonia-containing solution at a temperature of 800°C or less, preferably 600°C or less.